Corporate Social Responsibility as a Signaling Technology

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April 23, 2021*

Review of Managerial Science, forthcoming

Abstract

This study proposes a production framework in which capital, labor, and corporate social responsibility (CSR) generate sales. Estimating a stochastic frontier on an international sample of large manufacturing firms reveals that CSR has asymmetric effects on efficiency. In a matched sample, the processes of high as compared to low CSR firms are affected less by a crisis shock. This can be largely attributed to the role of CSR as an insurance signal of processes sustainability, especially in market-based as compared to network-oriented contexts. Finally, results show that higher CSR helps firms to mitigate a crisis shock on real effects such as profitability and sales growth; this is mostly because these firms have a higher ability to adjust their operating margins and exhibit lower risk.

Keywords: corporate social responsibility; efficiency; crisis; profitability; signaling

JEL codes: M1; M14; M21; M41

* I thank the Editor and two anonymous reviewers for useful comments and suggestions. This work received support from the Spanish Government through grants ECO2017-85763-R and CEX2019-000915-S. Usual disclaimers apply.

1. Introduction

Corporate social responsibility (CSR) remains a hot topic more than fifty years after Milton Friedman's (1970) influential New York Times piece. Friedman's seminal article argued that corporations should maximize shareholder value, while leaving socially responsible investments to explicit political processes with proper checks and balances. More recent contributions underscore the positive impact of CSR on organizational processes and performance (Eccles et al. 2014). Other posit that the CSR "production technology" of the firm exhibits reverse causality, with corporations investing in CSR when they anticipate performance increases (Lys et al. 2015). An underlying mechanism linking the two views may be that investing in CSR can lead to an effective stakeholder management (Hart and Zingales 2017; Foss and Klein 2018) with benefits such as better access to funding, an aspect on which accounting (Dhaliwal et al. 2011) and strategy (Cheng et al. 2014) scholars converge.

Instead of viewing CSR as an output, one can interpret it as a factor that contributes to sustainable results (Eccles et al. 2014) and shields the firm from unexpected crisis shocks by acting as an risk insurance mechanism (Lins et al. 2017; Shiu and Yang 2017; Kim et al. 2021). It can make economic sense to consider CSR as an input in a "sustainable production technology." Such perspective echoes the theoretical debates that highlight either the cost side of CSR (Friedman 1970; Jensen 2002) or recent approaches to "doing well by doing good" (Eichholtz et al. 2010; Porter and Kramer 2011). In a congruent view with seminal and novel perspectives, Hart and Zingales (2017) and Foss and Klein (2018) discuss how corporations should follow shareholder preferences but focus on shareholder and stakeholder welfare instead of short-term wealth. If CSR were to maximize welfare, then firms would pursue it; this is only so when CSR can be sustained through satisficing economic outcomes.

To uncover such economic outcomes, this work proposes a framework in which production function in which capital, labor, and CSR produce sales. It then estimates a stochastic frontier to examine whether CSR matters with asymmetric effects on technical efficiency, especially during a crisis. Next, the asymmetries are employed in a signaling approach to CSR, which can be more relevant in market-oriented contexts. Finally, the study contributes to long-lasting debates on the relationship between technical efficiency and firm real effects by unpacking the heterogeneous effects of a crisis on the profitability, growth and risk of firms with dissimilar levels of CSR.

The empirical analysis is conducted on an international sample of listed manufacturing firms. Data sources include Worldscope, Thomson Eikon and ASSET4 at the firm level, and the World Bank, Dhaliwal et al. (2012) and Guillén and Capron (2016) at the institutional level. To exploit the exogenous longitudinal variation provided by the global financial crisis captured by the VIX index, the sample comprises firms during pre-crisis 2005-2007 and crisis 2008-2010 periods.

To investigate whether CSR matters, the framework starts by specifying a traditional Cobb-Douglas function in which sales are produced using capital and labor. In a subsequent step, CSR is added as an input. Technical efficiency measurement follows the well-known stochastic frontier approach in Kumbhakar and Lovell (2003). The models estimate quadratic terms for all inputs, which can be relevant in the case of CSR; LópezPuertas-Lamy et al. (2017) show that exogenous evaluators display a nonlinear perception of the costs and risks embedded in CSR levels. There are three insights from the technical efficiency estimation. First, the estimators corresponding to the CSR terms are significant in the production function, and they create significantly more variation in firm level technical efficiency. While

higher CSR firms are not necessarily closer to the efficiency frontier, CSR levels help identifying meaningful variation in technical efficiency. Second, there can be diminishing returns to CSR. Third, the technical efficiency distribution during the crisis shifts to the left, and the higher overall inefficiency is mostly driven by the bottom quartile firms.

Next, the analysis focuses on the increased dispersion that CSR introduces in technical efficiency exploiting the exogenous longitudinal shock from the financial crisis. Endogeneity concerns that may remain in the cross-section are reduced through a coarsened exact matching. The matching provides two groups of firms that differ in CSR levels in the pre-crisis period but are statistically similar in other determinants of technical efficiency. Results show that the technical efficiency of high as compared to low CSR firms is affected less by the crisis. This result is robust to controlling for a wide array of firm-level financial and governance variables, as well as macroeconomic time-varying characteristics, and 3-digit industry and year effects. Since technical efficiency refers to underlying firm processes that are costly to create and difficult to imitate by outsiders, high CSR in good times can credibly signal the sustainability of such processes during economic distress periods. This can serve as an insurance to stakeholders that technical efficiency will suffer less when the marketplace features lower flexibility and scarcer capital.

Pushing this result a step further, heterogenous suggest that a signaling interpretation is stronger when competition is higher, and in general in market-oriented contexts as opposed to network-oriented ones. Ioannou and Serafeim (2012) have documented that different institutional configurations promote different levels of CSR. The evidence here is that with similar pre-crisis determinants of technical efficiency, high CSR firms suffer lower drops in technical efficiency with respect to low CSR firms when acting in market-oriented contexts.

However, the mitigating role of CSR is absent in network-oriented contexts. A mechanism behind this finding is that network-oriented contexts may put higher pressure on all firms to follow stakeholder interests (Desender and Epure 2020); this can introduce noise and foster a pooling equilibrium in the signaling environment. Conversely, in market-oriented contexts there can be a separating equilibrium as firm engage more freely in CSR, and having high CSR levels in good times can be more clearly interpreted as a credible signal of sustainably efficient processes during economic downturns.

Finally, the analysis goes beyond technical efficiency to identify firm real effects and their channels. While one can expect a crisis shock to only impact substantially the efficiency of firms with less sustainable processes, a financial distress period can affect the profitability and growth all firms. Findings illustrate that there is indeed a crisis impact on all firms, but high CSR dampens the drop in operating profitability and sales growth. Two potential underlying channels are that high CSR firms seem more able to adjust their operating margins and exhibit lower risk during crisis times.

This work contributes to the recent debates on the importance of firm and institutional factors for stakeholder management and perceived firm legitimacy (Foss and Klein 2018; Desender and Epure 2020; Kölbel and Busch 2020). It also extends the results of Eccles et al. (2014) showing that high CSR in good economic times can serve as a signal of sustainably efficient processes in crisis times. Such signals are stronger with higher levels of competition and in market-oriented contexts, which feature characteristics that help to enhance a signal's credibility. This finding bridges between results on firm processes and those on financial outcomes in general (Flammer 2015; Kang et al. 2016) or in crisis times (Lins et al. 2017). The crisis creates wider gaps between best and worst performers. Importantly, technical efficiency

results map into firm real effects with a one or two year lag, as high CSR firms suffer smaller drops in operating profitability, sales growth and margins. In addition, our results complement those in Becchetti et al. (2014) on the idiosyncratic risk related to CSR, by revealing that high CSR firms exhibit lower risk in crisis times (cf. Shiu and Yang 2017; Kim et al. 2021).

Contributing to the productivity and efficiency literature, this study shows that CSR matters in a production function – frontier analysis approach, a matter that has been an open question. Looking at historical productivity growth, Kumar (2006) provides evidence that TFP is sensitive to environmental practices. Shadbegian and Gray (2006) argue that CSR can distance firms from the efficiency frontier, while Becchetti and Trovato (2011) show that high CSR firms do not feature higher inefficiency. This work adds that CSR can uncover important variation in technical efficiency. Recently, Grifell et al. (2018) provided a unified productivity and efficiency framework for the role of firms in society. This study's design speaks to such long-lasting debates on translating efficiency into real effects.

2. Framework and models

2.1. Production with CSR

Economics and business studies often estimate technical efficiency (TE) using stochastic frontier models that take a log-linear Cobb-Douglas form. Following the specification in Kumbhakar and Lovell (2003):

$$\ln y_{it} = \alpha + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + v_{it} - u_{it} \quad (1)$$

where y_{it} is the output (sales) of producer i, $i = 1,\ldots,I$ at time t, $t = 1,\ldots,T$, and the inputs of producer i at time t are capital (K) and labor (L). The error term is decomposed into v_{it}, a two-sided noise component, and u_{it}, the non-negative TE component. The standard assumptions

are that the distribution of v_{it} is normal, and that of u_{it}, is half-normal. The best practice stochastic frontier can be represented by $\ln y^*_{it} = \alpha + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + v_{it}$. The estimation of a TE score, bounded between 0 and 1, is given by $\exp(-u_{it})$. In practical terms, an inefficient firm produces 1-TE percent less output compared to an efficient firm using the same amount of inputs.

Notably, TE is not simply a proxy of observed management practices (Triebs and Kumbhakar 2018), but of the fundamental and often unobserved ability to efficiently sustain processes that place the firm close to the best practice frontier. This understanding of TE echoes the sustainable processes in Eccles et al. (2014). Implementing the idea that CSR can help capturing the sustainability of firm processes, the model specification becomes:

$$\ln y_{it} = \alpha + \beta_1 \ln K_{it} + \beta_2 \ln L_{it} + \beta_3 \ln CSR_{it} + v_{it} - u_{it} \quad (2)$$

where CSR is the engagement of the firm in socially responsible practices. Here CSR is an input that contributes to shaping the production technology and can be represented by an observed, preferably by an exogenous source, net measure; this reduces the noise in the estimation of the frontier technology and provides a better representation of the sustainability of firm processes. An assumption in equation (2) is that firms have access to similar "production technology." This is a rather weak assumption in our case since the analysis will be based on large listed manufacturing firms. However, to mitigate concerns, enhanced specifications will identify TE within 3-digit industry subsectors and separately for pre-crisis and crisis periods. Furthermore, to adjust for both heteroskedasticity and serial correlation by firm in the time-series, standard errors are computed by clustering at the firm level.[1]

[1] Similar to Ioannou and Serafeim (2012) and Desender and Epure (2020), the specifications do not include firm fixed effects, as for most firms CSR does not vary significantly over multiple years (which can be especially the

While some have argued in favor of the benefits of CSR (Dhaliwal et al. 2011; Cheng et al. 2014; Eccles et al. 2014; Flammer 2015; Kang et al. 2016; Lins et al. 2017, to name just a few), evidence exists that CSR is not linked to current benefits (Lys et al. 2015) or that there are important costs of CSR, especially in terms of aligning interests and processes towards maximizing firm value (Prior et al. 2008). Overcoming this conundrum, LópezPuertas-Lamy et al. (2017) show that there exists a level of CSR at which external auditors perceive that the effort to understand firm processes and firm risk are minimized. Integrating such idea in the frontier technology described in equation (2) can be done via quadratic terms for inputs:

$$\ln y_{it} = \alpha + \beta_1 \ln K_{it} + \beta_2 \ln K^2_{it} + \beta_3 \ln L_{it} + \beta_4 \ln L^2_{it} + \beta_5 \ln CSR_{it} + \beta_6 \ln CSR^2_{it} + v_{it} - u_{it} \qquad (3)$$

where, in line with the rationale above, if CSR were beneficial for increasing the output, β_5 would be positive and significant. However, if there were diminishing returns to excessive levels of CSR, β_6 would be negative and significant.

2.2. The signaling value of CSR

The value of CSR may be to signal to outsiders the good prospects of the firm (Lys et al. 2015). Indeed, CSR can hold information akin to a credible signal as it fulfills the observability and costliness conditions (see Connelly et al. 2011; Spence 2002). This is especially so if the CSR measure comes from an exogenous evaluator that can act as a gatekeeper of the assessment of firm processes, and can also ensure the observability of CSR information. The signal is costly to produce and difficult to imitate given the dire requirements to secure a CSR listing, and maintain a CSR score benchmarked against relevant peers. The existence of a

case for the pre-crisis and crisis sub-samples). In the presence of firm fixed effects, the identification would be based only on those firms with changes in CSR, which would be necessarily incomplete.

gatekeeper for evaluating the costly production of CSR, and who can also act as an information disseminator, ensures the characteristics of a separating equilibrium in the signaling environment. Therefore, only high CSR firms can benefit from the signal, instead of all firms attempting to signal both true and false CSR in a pooling equilibrium.

How should a CSR signal be interpreted? On the one hand, Eccles et al. (2014) argue that CSR matters for organizational processes in general; on the other hand, Lins et al. (2017) argue that there are beneficial effects of CSR during crisis times. Our production framework allows to contrast such views and can show whether a CSR signal is mostly active in crisis times acting as an insurance mechanism (Shiu and Yang 2017; Kim et al. 2021). To examine the usefulness of the CSR signal, the identification strategy is based on the longitudinal exogenous shock of the global financial crisis. This helps mitigating usual endogeneity concerns, as well as filling a gap between key results in the literature. A baseline regression specification is:

$$TE_{it+1} = \alpha + \beta_1 Crisis + \beta_2 High\_CSR_{it} + \beta_3 Crisis \times High\_CSR_{it} + \mathbf{X}_{it}\eta + \psi_{it} + \varepsilon_{it} \quad (4)$$

where TE is the technical efficiency score estimated from equation (3). Equation (4) includes firm and time varying financial, governance and macroeconomic characteristics ($\mathbf{X}_{it}$). It also includes 3-digit industry classification fixed effects (ψ_{it}).[2] Standard errors are clustered at the firm level.

The coefficients of interest are β_1 and β_3, which show the impact of the crisis shock and its change for high CSR firms (as compared to low CSR ones). Specifically, the term *Crisis*×*High_CSR* takes the value of one if there is a crisis and the firm has a high level of CSR

[2] Additional specifications also include year effects. However, when such effects are included, the interpretation of the crisis effect will be reduced to the year omitted from the estimation due to collinearity with the crisis indicator.

in the industry-year pair, and is zero otherwise. Alternative specifications will employ the continuous CSR score and check for potential nonlinear effects. The crisis represents an exogenous longitudinal shock; to further reduce endogeneity concerns in the cross-section, we use coarsened exact matching to obtain two groups that have high and low CSR pre-crisis, but are statistically similar in relevant determinants of TE. Section 4.2. further describes the empirical matching process and its results. In line with the proposed framework, the predicted signs are negative for β_1 and positive for β_3, which would act as an informative signal on the sustainability of firm processes in a crisis.

Moving to study the heterogeneity of such predictions, a CSR signal can hold a differential value depending on competition levels and institutional configurations that can be market or network-oriented. Connelly et al. (2011) point to an often-ignored importance of the context in signaling studies. Drawing on the theoretical and empirical insights from Aguilera et al. (2007), Matten and Moon (2008), Ioannou and Serafeim (2012) and Desender and Epure (2020), one can expect CSR to hold a different meaning depending on the context. On the one hand, market-oriented contexts feature open impersonal exchanges, individual responsibility and lower pressure on firms to engage in non-market activities such as CSR, as long as these are not requested by shareholders (Hart and Zingales 2017). On the other hand, network-oriented contexts are characterized by personal exchanges with known stakeholders, collective responsibility and institutional pressures to engage in activities such as CSR that are beneficial for a wider set of stakeholders (see Freeman et al. 2010). A credible signal of sustainable processes would appear in contexts in which the signal is produced willingly by the firm in the absence of strong external pressures to engage in CSR, such as legitimacy to

mitigate risk (Kölbel and Busch 2020). We thus expect a CSR signal to hold more value in a market-oriented context.

Finally, if CSR holds a signaling value in crisis times this should later materialize in real effects such as profitability and growth. To scrutinize this hypothesis, we estimate:

$$Real\_effect_{it+\tau} = \alpha + \beta_1 Crisis + \beta_2 High\_CSR_{it} + \beta_3 Crisis \times High\_CSR_{it} + \mathbf{X}_{it}\eta + \psi_{it} + \varepsilon_{it} \quad (5)$$

where the dependent variable captures profitability or growth, and τ can take the value of one or two years. The rest of terms are similar to the ones described in equation (4) and for robustness a control for technical efficiency can be included. Going beyond the examination of real effects, we uncover their underlying channels. If some high CSR firms suffer less in crisis times, this may be due to a higher flexibility in adjusting operating margins, as well as a lower firm risk.

3. Data and variables

3.1. Data sources and sample

The dataset draws on multiple sources including Worldscope, Refinitiv Eikon and ASSET4 at the firm level, and the World Bank, Dhaliwal et al. (2012) and Guillén and Capron (2016) at the institutional level. Given the production frontier focus, the sample comprises manufacturing firms with available CSR data for the studied period. The final dataset contains 3,606 firm-year observations from 21 countries over the period 2005-2010. A *crisis* variable takes the value of one during the main years of the global financial crisis (2008-2010), and zero for the pre-crisis years 2005-2007. This choice is supported by the VIX index, which captures

the market prices implied uncertainty and is widely used to proxy for volatility and investor risk appetite.[3]

3.2. Variables

Corporate social responsibility. CSR is captured by a score of social and environmental metrics available from ASSET4. This dataset has been validated by the studies of Ioannou and Serafeim (2012), Cheng et al. (2014), Eccles et al. (2014), Lys et al. (2015) and Desender and Epure (2020) among others. The dataset includes benchmarked CSR scores for companies listed on major stock exchanges around the world. Analysts compute over 250 key performance indicators using more than 750 data points from multiple sources such as stock exchange filings, firm CSR and annual reports, nongovernmental organizations' websites, and news sites. The obtained firm level social and environmental scores range between 0 and 100 and account for peer group comparisons. To give some examples, the environmental pillar includes ratings on resources and emission reduction, and product innovation benefiting the environment. The social pillar measures the firm's product responsibility, community, human rights, training and development, health and safety, and employment quality. Similar to Ioannou and Serafeim (2012), Lys et al. (2015) and Desender and Epure (2020), the composite net CSR score does not include financial performance and corporate governance, and is defined as the average of the social and environmental scores.

[[Insert Table 1 about here]]

[3] Note that the crisis dummy defines symmetric pre- and crisis windows. Also, especially the European VIX maintained relatively high levels during 2010. Dropping 2010 from the analysis is expected to yield more pronounced differences between pre- and crisis periods.

Variables for the stochastic frontier estimation. The first four rows of Table 1 summarize the variables included in the stochastic frontier estimation. Firms have an average CSR score of 65 out of 100, with a standard deviation of 26. The values for average sales and capital (measured as fixed and current assets) confirm that the sample includes large manufacturing firms. The average firm has about 16,000 employees.

Financial variables. First, specifications include a control for size, which can be an important predictor of both CSR and performance (Ioannou and Serafeim 2012, Lys et al. 2015). Second, we include liquidity (cash to sales) and leverage (liabilities to assets) ratios, which can affect CSR and performance especially in crisis times (Duchin et al. 2010). Since firms with innovative practices can be more oriented to CSR, results are validated controlling for the levels of intangible assets and R&D expenses. Performance effects and their channels are scrutinized computing operating ROA as the ratio of operating income to total assets, year-on-year sales growth and an operating margin as the ratio of operating income to sales.

Governance variables. Ioannou and Serafeim (2012), as part of their control variables, and Desender and Epure (2020) highlight the importance of corporate governance for CSR, whereas its importance for performance is well known. Thus, we control for strategic holdings (the sum of ownership shares of at least 5%), the percentage of independent directors on the board, an indicator variable for CEO duality (i.e. if the CEO acts as chairman of the board), the percentage of women on the board of directors, and the size of the board of directors.

Market and network contexts. We use four measures to operationalize market- and network-oriented contexts. First, the level of competition is measured using a sales-based Herfindahl-Hirschman Index (HHI). Second, we employ an indicator for the existence of a mandatory law for CSR disclosure. Third, we use Dhaliwal et al.'s (2012) stakeholder orientation index, which

is a principal component of the legal environment of a country in protecting labor rights, the existence of mandatory disclosure of CSR, and the public awareness of CSR issues. Fourth, we employ the Guillén and Capron (2016) index of minority shareholder rights protection. For each measure, an indicator variable splits the sample by the median value to define market contexts as high competition, no mandatory CSR disclosure, low stakeholder orientation and high shareholder protection, respectively; and network contexts as their counterparts.

Macroeconomic controls. To control for time-varying macroeconomic conditions, specifications include the market capitalization of listed companies (percentage of GDP), GDP per capita, and GDP growth.

4. Results

4.1. Technical efficiency: Estimation

Table 2 presents the results of the stochastic frontier estimation. Column (1) is a general specification that includes capital and labor in the production function, while column (2) adds CSR. In the baseline specification, the coefficients for capital and labor are positive and significant, as expected, however CSR loads negatively. Columns (3) and (4) reveal that when adding the quadratic terms, the level CSR effect is positive and larger than the negative quadratic CSR term. This result is in line with the conjectures presented in Section 2: CSR is incrementally beneficial for increasing the output, but there are diminishing returns to excessive levels of CSR. Notably, the slope of the positive CSR main term is substantially larger than the negative slope of the quadratic CSR term. Similar to CSR estimates, columns (3) and (4) show that firms may experience input congestion at higher level of employees. Columns (5) and (6) illustrate that estimates follow analogous patterns for pre-crisis and crisis

periods. Finally, columns (7) to (10) confirm all results by adding 3-digit industry classification fixed effects and clustering standard errors at the firm level.

[[Insert Table 2 and Figure 1 about here]]

The two bottom rows of Table 2 summarize the technical efficiency (TE) scores. Mean values range between 66% and 70%, with pre-crisis TE about 2% higher than during the crisis. This difference largely driven by the bottom quartile firms, which can be indicative that the crisis affected more direly the processes of lower TE firms. Accordingly, the crisis brings wider gaps between better and worse performers (see, e.g., Epure 2016). Figure 1 serves to illustrate this point by juxtaposing pre-crisis and crisis TE scores.

Following Eccles et al. (2014), we expect CSR to help explaining within firm sustainability of processes and not necessarily the distance to the frontier, as previous studies have shown that it may not be the case (e.g. Becchetti and Trovato 2011). To test this conjecture, we compare the within firm standard deviations over a moving 3-year window for TE estimates corresponding to the quadratic functions without (column 3 of Table 2) and with (column 4) CSR. Tests of differences between means (t-test) or distributions (Kolmogorov-Smirnov) show that there is a significant difference ($p<0.000$) between the two sets of estimations.

4.2. Technical efficiency: Asymmetric crisis effects on a high-low CSR matched sample

Appendix Table A1 investigates the main determinants of TE. In the cross-section, complexity proxied by a large size, high liquidity and leverage can hinder TE. However, when controlling for other governance and macroeconomic characteristics as well as unobserved heterogeneity,

firm size captures most of the effect. Importantly, investing in innovation (proxied as a stock by intangible assets or as a flow by R&D expenses) is positively associated with TE. Perhaps surprisingly, recommended corporate governance practices such as board independence or separating the roles of CEO and chairman of the board do not have a significant relation to TE. In most complete specifications, the presence of strategic holdings and women on board are negatively associated to TE.

Before moving to explore crisis effects, we create two high and low CSR matched samples to mitigate endogeneity concerns in the cross-section. In the pre-crisis period, firms can choose to invest differently in CSR, even if they are similar in other respects. If CSR were not to matter for TE in crisis times, then firms which are different in CSR but otherwise similar in the pre-crisis period would not display differential responses to the crisis in terms of sustaining efficient processes. We use coarsened exact matching to obtain two groups that have high and low CSR pre-crisis (yearly median split), but are statistically similar in the relevant determinants of TE. Appendix Table A2 presents the results of the matching. Importantly, the two groups that differ in CSR levels are statistically similar not only in financial information (total assets, liquidity, and leverage), but also in governance (ownership and women on board), level of intangible assets and ROA. Thus, when comparing the response to the crisis shock of the two groups, the differential effect can be largely attributed to sustaining efficient processes.

[[Insert Table 3 about here]]

Table 3 presents the results of the crisis effect on the TE of firms with different CSR levels. In all specifications, standard errors are clustered at the firm level to adjust for heteroskedasticity and serial correlation by firm (clustering standard errors at the firm-year pair

yields similar results). Columns (1) shows that, in the matched sample, there is no significant relationship between CSR and TE. This result holds controlling for the full set of financial, governance and macroeconomic characteristics, as well as industry and year effects (column 2). Colum (3) shows that there is a negative shock of the crisis on the TE of all firms. However, such effect is significantly lower on the TE of high CSR firms (column 4). The estimates hold economic significance: while the crisis induces a shock of about 2.5 percentage points in TE (with respect to the average), the effect is significantly lower for high CSR firms by about 2.2 percentage points. Column (5) corroborates the result in the presence of year fixed effects, which capture the statistical effect of the crisis dummy. Next, column (6) validates the results employing the continuous CSR score. This variable allows to check for potential nonlinearities. Columns (7) and (8) show that while there could be a nonlinear relationship between CSR and TE, this is not significant.

[[Insert Figure 2 about here]]

Figure 2 helps to understand better the relationship between CSR and TE in a crisis. The upper part of the figure plots the estimates of the interaction term *Crisis×ln(CSR)* alongside 95% confidence intervals. The regression includes the full set of controls from Table 3 as well as 3-digit industry effects; standard errors are clustered at the firm level. The lower part of the figure plots the density of *ln(CSR)*. While in the pre-crisis period there is no incremental effect of CSR (left panel), in the crisis period the negative shock is significantly dampened as CSR increases (right panel). Overall, the results submit that sustainably efficient processes can help firms to mitigate a crisis shock (e.g. Lins et al. 2017) by providing an insurance-like effect (e.g. Shiu and Yang 2017; Kim et al. 2021).

4.3. Heterogeneous effects by context

The findings above corroborate that pre-crisis CSR can be a viable signal for the sustainability of firm processes in a crisis. The signal's production is costly due to the investment in CSR and its safeguarding. External gatekeepers (i.e. analysts constructing and benchmarking CSR scores) ensure a separating equilibrium in which the signal is observable and difficult to mimic by low CSR firms. This section follows the suggestion in Connelly et al. (2011) to explore the neglected role of the context for the signal's strength and importance.

[[Insert Table 4 about here]]

To this purpose, we estimate the model in column (4) of Table 3 on the matched sample, splitting between firms headquartered in market and network contexts. Table 4 presents the results from four different definitions of market and network contexts. The contexts are classified using the level of competition defined through a sales-based HHI (columns 1 and 2), the existence of mandatory CSR disclosure laws (columns 3 and 4), the pressure to engage with a broader set of stakeholders (columns 5 and 6), and the level of shareholder protection (columns 7 and 8). In all cases, high CSR diminishes the negative shock of a crisis when the firm is located in a less network and more market context.[4]

Taking the results in Table 4 together, the evidence suggests that not only the importance to engage in CSR can differ by context, but the context can also matter for how having engaged in CSR pre-crisis relates to the crisis impact on firm processes. As Section 2.2. has argued, a credible signal of sustainable practices would appear in the absence of strong external pressures to engage in CSR. The results in this section support that this is the case in

[4] Results are robust to including year effects.

market (as opposed to network) contexts that favor focusing on firm value and impersonal exchanges.

4.4. Real effects

The last step is the analysis of the link between efficiency and profitability, a subject of long-lasting debates (see, e.g., Balk 2003). While for technical efficiency one can expect the negative shock of a crisis to only impact substantially those firms with less sustainable processes, in terms of profitability a financial distress period can affect all firms. This section examines the real effects of the crisis and the underlying channels through which negative effects may propagate.

[[Insert Table 5 about here]]

Table 5 shows that the operating profitability (ROA) of all firms is negatively affected by the crisis, with effects that appear with one-year lag (column 1), and become larger with two lags (column 2, a 3.8 percentage points drop with respect to average ROA). However, this drop during the crisis is lower by 1.9 percentage points for high CSR firms. This result is obtained using the empirical identification and full set of controls in column 4 of Table 3, as well as TE; it is also robust to including year fixed effects. When looking at sales growth, columns (3) and (4) support the profitability results by showing that in real terms, high CSR firms lose substantially less sales with respect to low CSR firms, especially with a two-year lag.

Such effects can have different underlying channels in terms of firm responses to the crisis. Previous results have shown that a main mechanism behind these results is the ability of sustaining efficient processes. In terms of real effects, it may also be that firms suffering decreases in sales are unable to adjust their operating margins or maintain cash flows. Columns

(5) and (6) show that while all firms experience a negative shock of the crisis in their operating margins, especially with a two-year lag high CSR firms are better able to adjust such margins. This may be due to their lower volatility. Indeed, in column (7) there is a positive crisis effect on the standard deviation of the previous three years' operating margin of the firms; nevertheless, this increased risk is lower in crisis times for high CSR firms. In a similar vein, high CSR firms exhibit lower risk also in terms of the ratio of cash to sales, which they are better able to maintain or adjust. Uncovering the risk channel in the crisis stages offers a natural bridge between the crisis shock on firm efficiency and their subsequent negative real effects.

5. Discussion and conclusion

The relationship between CSR, processes and outcomes attracts the attention of researchers and practitioners alike. In light of the growing pressure towards CSR awareness, even traditional investment firms such as BlackRock recommended corporations to go beyond profit maximization and contribute to society (New York Times 2018). Such opinions have already been voiced in the post-crisis period by the Norwegian sovereign wealth fund. These investor messages link to recent contributions that advocate for shareholder welfare (Hart and Zingales 2017) or update beliefs on Friedman (1970) by focusing on integrated stakeholder management (Foss and Klein 2018).

5.1. From sustainably efficient processes to real effects

Instead of specifying an objective function with a double bottom line which can be particularly cumbersome to manage (Jensen 2002), this study shows that there exists a production function

with CSR as an input that integrates shareholder-focused views (Freidman 1970) with hybrid approaches to morality in production (Cyert and March 1963; Arrow 1973). This work demonstrates that using CSR as an input matters for variation in technical efficiency. Since technical efficiency is understood as the ability to sustain processes benchmarked to a best practice frontier (Triebs and Kumbhakar 2018), this result links to important contributions that have connected CSR to organizational processes and performance (Eccles et al. 2014). Results show that it is not necessarily that higher CSR firms are closer to the efficiency frontier, but instead high as compared to low CSR firms even if similar in other respects are more able to sustain efficient processes in a crisis. In economic terms, there is a large negative shock—of about 2.5 percentage points with respect to the average—of the crisis on the technical efficiency of all firms; however, for high CSR firms this effect is substantially lower.

Thus, CSR can serve as a signal of process sustainability to insure the firm relationships with a broad range of stakeholders. As this work argues, the theoretical conditions are fulfilled in a CSR signaling framework. A process sustainability signal in times of economic distress can be interpreted as a team production effort towards protecting long-run interests. In their model of corporate team production, Blair and Stout (1999) argue that there is a joint welfare function of all firm stakeholders; this paper shows that if CSR were to capture a broader stakeholder focus, then technical efficiency with CSR as input can be a useful signal of processes' sustainability.

There is one important nuance to the signal. Theoretically, a signal is credible when not all firms are pressured to produce it and its production is costly in a relevant way. Discussing Blair and Stouts' (1999) corporate team production model, Klein et al. (2012) argue that claims on firm outcomes should be proportional to the involvement in the organization. Accordingly,

the cost of CSR is immediate for shareholders and the benefit is shared on the long term among multiple stakeholders. A signal of CSR engagement even when the institutional context favors shareholders' preferences is more credible than a signal in a context that pressures all firms towards CSR. In this line, we have shown that signaling process sustainability has stronger effects in crisis times in market contexts that focus on firm value and impersonal exchanges. In contrast, in network contexts which favor personal exchanges between known stakeholders, the signal loses value.

Finally, joining the shareholder and stakeholder approaches to the firm, the analysis has uncovered the real effects of a CSR signal of sustainable efficiency in a crisis. From a property rights perspective, claims on firm outcomes should be proportional to the stakes in the firm (cf. Klein et al. 2012). Firms that have invested more in stakeholder interests pre-crisis suffer lower decreases in operating profitability and sales growth during a crisis. Indicatively, the crisis induces a drop in profitability as large as 3.8 percentage points with respect to the average ROA; this drop is about half in the case of high CSR firms. The crisis real effects propagate through channels such as a lower ability to adjust operating margins, as well as a higher risk in the crisis stages. Overall, the real effects analysis corroborates that pre-crisis CSR can serve as an insurance in the marketplace of the ability of a firm to shield itself from negative shocks.

5.2. Implications for research and practice

This work can serve as a steppingstone for future frameworks on firm sustainability and its effects. In a recent review, Ormazabal (2018) highlights potential misalignments between the interests of stakeholders, shareholders, and the general public. The proposed framework for

integrating CSR in a production function and using the resulting technical efficiency estimates as a proxy for sustainable processes can align some diverging views on what has long been regarded as a non-market strategy. Existing research has showed that CSR and social enterprises exhibit overlaps (Palakshappa and Grant 2018) and that socially responsible investment is tightly interconnected with the community in which the firm operates (Johnson and Greening 1999). This work argues that the sustainability of firm processes is not separable from CSR, which can serve as a signal to investors and other stakeholders on the company's operating fundamentals that crises put to dire tests.

As we have argued, such signals function best in market contexts. Future work can extend this research line by a more granular identification of Williamson's (2000) levels of social analysis. This work focuses on the core: the resource allocation and processes of the firm, and their interpretation in different institutional contexts; it thus provides a natural next stage of analysis to the institutional determinants of CSR in Ioannou and Serafeim (2012) and their interaction with ownership in Desender and Epure (2020). Next studies could narrow down on private contracting at the micro level of the firm.

Taking all levels of analysis together, policy makers can engage in comparative institutional analyses which weigh the possible benefits of pushing for CSR through regulatory interventions against the potential costs of introducing noise in the signaling environment. The outcomes of such comparative analysis should be congruent with how transactions tend to be organized in the local context. The CSR signal holds more value when transactions tend to have an impersonal (market) rather than personal (network) nature. Accordingly, this study also serves to better understand that the role of firm level CSR can be contingent on the complexity of institutional configurations.

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Figure 1. Technical efficiency with CSR in pre-crisis and crisis

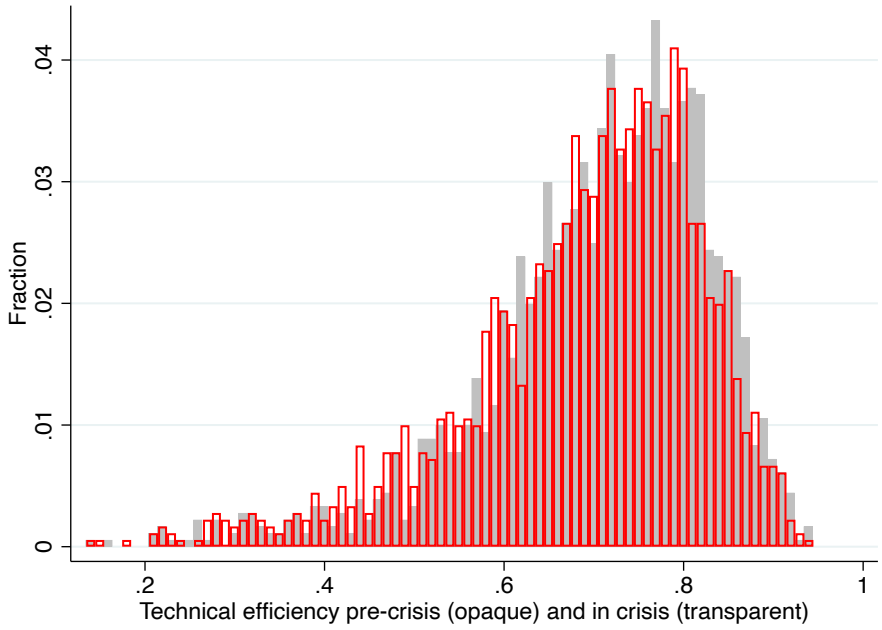

Figure 2. Crisis effects and CSR

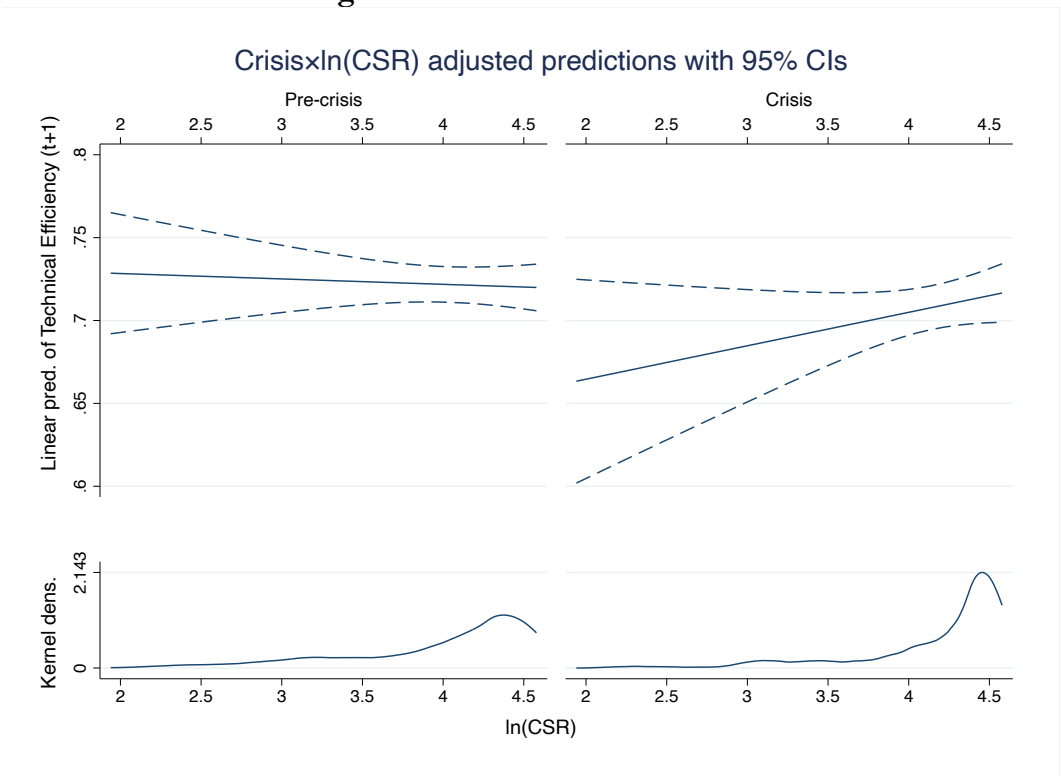

Table 1. Summary statistics

	Obs.	Mean	Std. dev.	Q1	Median	Q3
ln(CSR)	3606	4.0486	0.5786	3.7935	4.2974	4.4784
ln(Sales)	3606	16.8743	2.5047	14.9720	16.2383	19.2737
ln(Capital)	3606	16.7300	2.5997	14.7387	16.0113	19.3203
ln(Employees)	3606	9.7023	1.1599	8.9086	9.7291	10.4740
ln(Total assets)	3606	16.9296	2.5071	14.9760	16.3466	19.3630
Cash to sales	3510	11.1878	7.0961	6.5200	9.8050	13.9500
Leverage	3574	0.5764	0.1686	0.4750	0.5907	0.6933
ln(Intangibles)	3606	14.0862	2.6577	12.8250	14.3608	15.7095
ln(R&D)	2796	12.4791	3.9787	10.7211	12.6679	15.5398
ROA	3532	0.0915	0.0572	0.0515	0.0831	0.1223
ΔSales	2946	0.0394	0.1447	-0.6801	-0.0103	0.0607
Operating margin	3533	0.0998	0.0704	0.0503	0.0861	0.1353
Strategic holdings	3572	22.5470	20.8774	6.0000	16.0000	33.0000
Board independence	1791	55.2340	31.7605	33.3300	60.0000	83.3300
CEO duality	3558	0.3454	0.4756	0.0000	0.0000	1.0000
Women on board	3541	7.0859	9.6102	0.0000	0.0000	12.5000
Board size	3537	11.0116	3.8658	8.0000	10.0000	13.0000

lnCSR is the logarithm of the average of the social and environmental scores from ASSET4. ln(Sales) is the logarithm of the value of total firm sales. ln(Capital) is the logarithm of the sum of the value of fixed and current assets. ln(Employees) is the logarithm of the number of employees. ln(Total Assets) is the logarithm of the book value of total firm assets. Cash to sales is the ratio of firm cash to total sales. Leverage is the ratio of total liabilities to total assets. ln(Intangibles) is the logarithm of the value of intangible assets. ln(R&D) is the logarithm of research and development expenses. ROA is the ratio of operating income to total assets. ΔSales is the year-on-year change in sales. Operating margin is the ratio of operating income to total sales. Strategic holdings is defined as the sum of ownership shares of at least 5%. Board independence is the percentage of independent board members. CEO duality is a dummy variable that takes the value of one if the firm CEO is also the chairman of the board, and zero otherwise. Women on board is the percentage of women on the board of directors. Board size is the number of members of the board of directors.

Table 2. A stochastic frontier with CSR

y: ln(Sales)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	All	All	All	All	Pre-crisis	Crisis	All: Ind. effects	All: Ind. effects and firm SEs	Pre-crisis: Ind. effects and firm SEs	Crisis: Ind. effects and firm SEs
ln(Capital)	0.9270***	0.9279***	0.4691***	0.4467***	0.4664***	0.4212***	0.5233***	0.5233***	0.5227***	0.5171***
	(0.0027)	(0.0027)	(0.0422)	(0.0416)	(0.0552)	(0.0629)	(0.0446)	(0.1184)	(0.1157)	(0.1298)
ln(Capital)^2			0.0132***	0.0140***	0.0134***	0.0147***	0.0118***	0.0118***	0.0118***	0.0121***
			(0.0012)	(0.0012)	(0.0016)	(0.0018)	(0.0013)	(0.0034)	(0.0033)	(0.0037)
ln(Employees)	0.1116***	0.1266***	0.8423***	0.8877***	0.7763***	1.0040***	0.8941***	0.8941***	0.7757***	1.0275***
	(0.0065)	(0.0068)	(0.0724)	(0.0709)	(0.0949)	(0.1057)	(0.0703)	(0.1993)	(0.1843)	(0.2300)
ln(Employees)^2			-0.0366***	-0.0376***	-0.0322***	-0.0432***	-0.0381***	-0.0381***	-0.0322***	-0.0445***
			(0.0037)	(0.0036)	(0.0049)	(0.0054)	(0.0036)	(0.0101)	(0.0094)	(0.0115)
ln(CSR)		-0.0917***		0.4730***	0.5311***	0.5554**	0.5713***	0.5713**	0.5989**	0.6952*
		(0.0132)		(0.1364)	(0.1719)	(0.2256)	(0.1336)	(0.2554)	(0.2386)	(0.3841)
ln(CSR)^2				-0.0819***	-0.0925***	-0.0930***	-0.0923***	-0.0923***	-0.0989***	-0.1088**
				(0.0188)	(0.0241)	(0.0307)	(0.0185)	(0.0350)	(0.0332)	(0.0518)
Constant	0.7293***	0.9423***	0.9686*	0.2519	0.5467	-0.2357	-0.6959	-0.6959	-0.1354	-1.5183
	(0.0739)	(0.0793)	(0.5098)	(0.5603)	(0.7323)	(0.8633)	(0.5621)	(1.5961)	(1.4701)	(1.9297)
$\ln(\sigma^2_v)$	-2.4796***	-2.5249***	-2.4645***	-2.5486***	-2.6209***	-2.5266***	-2.5216***	-2.5216***	-2.5853***	-2.4826***
	(0.0578)	(0.0582)	(0.0579)	(0.0588)	(0.0829)	(0.0846)	(0.0633)	(0.1624)	(0.1642)	(0.1741)
$\ln(\sigma^2_u)$	-1.1341***	-1.1210***	-1.2705***	-1.2480***	-1.3207***	-1.1624***	-1.4409***	-1.4409***	-1.5093***	-1.3863***
	(0.0543)	(0.0527)	(0.0601)	(0.0568)	(0.0801)	(0.0782)	(0.0708)	(0.1865)	(0.1999)	(0.1859)
Obs.	3606	3606	3606	3606	1803	1803	3606	3606	1803	1803
Mean TE	0.6615	0.6605	0.6766	0.6749	0.6839	0.6647	0.6968	0.6968	0.7050	0.6901
TE std. dev.	0.1475	0.1475	0.1391	0.1429	0.1402	0.1478	0.1297	0.1297	0.1268	0.1324

Results from the estimation of the stochastic frontier as described in Sector 2.1. Variables are described in Section 3.2. and Table 1.
TE stands for technical efficiency. * p<0.10, ** p<0.05, *** p<0.01

Table 3. Crisis effects on the technical efficiency of high CSR firms: Matched sample

y: TE_{it+1}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CSR variable:	High_CSR	High_CSR	High_CSR	High_CSR	High_CSR	Ln(CSR)	Ln(CSR)	Ln(CSR)
Sample:	All	All	All	All	All	All	Pre-crisis	Crisis
CSR_{it}	0.0107	0.0106	0.0109	0.0019	0.0017	-0.0033	-0.0360	-0.2001
	(0.0086)	(0.0085)	(0.0085)	(0.0093)	(0.0093)	(0.0085)	(0.0982)	(0.1527)
Crisis			-0.0136**	-0.0247***	-0.0016	-0.1106**		
			(0.0068)	(0.0084)	(0.0069)	(0.0497)		
$Crisis \times CSR_{it}$				0.0217**	0.0214**	0.0234*		
				(0.0109)	(0.0108)	(0.0120)		
CSR^2_{it}							0.0051	0.0285
							(0.0135)	(0.0203)
$Ln(Total\ assets)_{it}$	-0.0037	-0.0039	-0.0035	-0.0037	-0.0041	-0.0039	-0.0017	-0.0055
	(0.0047)	(0.0046)	(0.0047)	(0.0047)	(0.0046)	(0.0048)	(0.0044)	(0.0065)
$Cash\ to\ sales_{it}$	-0.0064***	-0.0063***	-0.0064***	-0.0064***	-0.0062***	-0.0063***	-0.0077***	-0.0051***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0016)	(0.0019)
$Leverage_{it}$	-0.0022	-0.0027	-0.0028	-0.0023	-0.0023	0.0003	-0.0085	0.0035
	(0.0521)	(0.0515)	(0.0519)	(0.0520)	(0.0515)	(0.0525)	(0.0493)	(0.0675)
$Strategic\ holdings_{it}$	-0.0001	-0.0002	-0.0001	-0.0001	-0.0002	-0.0001	-0.0000	-0.0005
	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0005)
$CEO\ duality_{it}$	0.0034	0.0021	0.0031	0.0030	0.0019	0.0031	0.0089	-0.0092
	(0.0095)	(0.0096)	(0.0095)	(0.0095)	(0.0096)	(0.0095)	(0.0095)	(0.0133)
$Women\ on\ board_{it}$	0.0005	0.0006	0.0005	0.0005	0.0005	0.0005	0.0008	-0.0001
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0007)
$Board\ size_{it}$	-0.0007	-0.0006	-0.0007	-0.0008	-0.0006	-0.0006	-0.0002	-0.0004
	(0.0014)	(0.0015)	(0.0014)	(0.0014)	(0.0015)	(0.0014)	(0.0014)	(0.0019)
$ln(Intangibles)_{it}$	0.0067*	0.0072**	0.0069**	0.0066*	0.0070**	0.0069*	0.0041	0.0073
	(0.0035)	(0.0035)	(0.0035)	(0.0034)	(0.0034)	(0.0036)	(0.0035)	(0.0049)
$ln(R\&D)_{it}$	0.0048*	0.0047*	0.0047*	0.0048**	0.0048*	0.0049**	0.0020	0.0096**
	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0020)	(0.0038)
$ln(Mkt.\ cap./GDP)_{it}$	0.0408***	0.0398**	0.0384**	0.0391**	0.0404**	0.0393**	0.0155	0.0596***
	(0.0152)	(0.0181)	(0.0154)	(0.0154)	(0.0181)	(0.0154)	(0.0182)	(0.0167)
$GDP\ growth_{it}$	-0.0007	-0.0034	-0.0021	-0.0025	-0.0040	-0.0023	0.0012	-0.0062*
	(0.0031)	(0.0042)	(0.0029)	(0.0029)	(0.0042)	(0.0029)	(0.0058)	(0.0034)
$ln(GDP\ per\ capita)_{it}$	0.0359	0.0617	0.0535	0.0514	0.0600	0.0488	0.0827*	0.0714
	(0.0395)	(0.0456)	(0.0440)	(0.0443)	(0.0458)	(0.0446)	(0.0478)	(0.0603)
Constant	0.1227	-0.1492	-0.0477	-0.0178	-0.1310	0.0174	-0.1446	-0.0409
	(0.4451)	(0.4942)	(0.4852)	(0.4878)	(0.4932)	(0.4896)	(0.5128)	(0.7614)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	No	No	Yes	No	No	No
R-squared	0.160	0.177	0.162	0.165	0.179	0.163	0.158	0.232
Obs.	1142	1142	1142	1142	1142	1142	668	474

The dependent variable is technical efficiency (TE) in period t+1, obtained from the estimations in columns (9) and (10) in Table 2. Crisis is a dummy that takes the value of 1 for years 2008-2010, and zero for 2005-2007. High CSR is a dummy variable equal to one if the firms CSR level is above the median-year CSR, and zero if the firm's CSR score is below the median-year value. lnCSR is the logarithm of the average of the social and environmental scores from ASSET4. Complete definitions of all other variables are provided in Section 3.2 and Table 1. Firm-clustered standard errors are presented in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

Table 4. Heterogeneous effects by context

y: TE_{it+1}	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Network	Market	Network	Market	Network	Market	Network	Market
	HHI: Moderate ind. comp.	HHI: High ind. comp.	CSR disclosure law	No CSR disclosure law	High stakeholder orientation	Low stakeholder orientation	Low Guillen-Capron	High Guillen-Capron
Crisis	-0.0184	-0.0202**	-0.0350*	-0.0232**	-0.0367*	-0.0077	-0.0391**	-0.0177**
	(0.0149)	(0.0097)	(0.0199)	(0.0095)	(0.0195)	(0.0081)	(0.0192)	(0.0087)
$High\_CSR_{it}$	-0.0091	0.0163	0.0086	0.0091	0.0037	0.0200*	-0.0045	0.0119
	(0.0172)	(0.0110)	(0.0166)	(0.0113)	(0.0139)	(0.0120)	(0.0156)	(0.0111)
$Crisis \times High\_CSR_{it}$	0.0076	0.0211*	0.0123	0.0289**	0.0121	0.0334***	0.0189	0.0235*
	(0.0215)	(0.0121)	(0.0192)	(0.0123)	(0.0171)	(0.0120)	(0.0185)	(0.0130)
Financial controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Governance controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.226	0.203	0.356	0.192	0.303	0.254	0.287	0.188
Obs.	402	740	382	752	486	648	420	714

Matched samples. The dependent variable is technical efficiency (TE) in period t+1, obtained from the estimations in columns (9) and (10) in Table 2. Crisis is a dummy that takes the value of 1 for years 2008-2010, and zero for 2005-2007. High CSR is a dummy variable equal to one if the firms CSR level is above the median-year CSR, and zero if the firm's CSR score is below the median-year value. The controls are ln(Total assets), cash to sales, leverage, strategic holdings, CEO duality, women on board, board size, ln(Intangibles), ln(R&D), ln(Mkt. cap./GDP), GDP growth and ln(GDP per capita); complete definitions are provided in Section 3.2 and Table 1. Firm-clustered standard errors are presented in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

Table 5. Real effects

y:	(1) ROA_{it+1}	(2) ROA_{it+2}	(3) $\Delta Sales_{it+1}$	(4) $\Delta Sales_{it+2}$	(5) Operating $margin_{it+1}$	(6) Operating $margin_{it+2}$	(7) σOperating margin	(8) σCash to sales
Crisis	-0.0134***	-0.0387***	-0.0826***	-0.2180***	-0.0143***	-0.0378***	0.0024**	0.2767***
	(0.0036)	(0.0050)	(0.0124)	(0.0175)	(0.0034)	(0.0050)	(0.0012)	(0.1057)
$High\_CSR_{it}$	-0.0077**	-0.0075*	-0.0359***	-0.0057	-0.0051	-0.0065*	0.0039**	0.2848**
	(0.0036)	(0.0039)	(0.0093)	(0.0102)	(0.0031)	(0.0037)	(0.0016)	(0.1375)
$Crisis \times High\_CSR_{it}$	0.0105**	0.0190***	0.0616***	0.0509**	0.0036	0.0162**	-0.0032*	-0.3054**
	(0.0044)	(0.0066)	(0.0162)	(0.0235)	(0.0044)	(0.0068)	(0.0016)	(0.1463)
TE_{it}	0.2008***	0.1811***	0.0734	0.1079**	0.0677***	0.0605***	-0.0068	-1.5095***
	(0.0159)	(0.0174)	(0.0475)	(0.0528)	(0.0175)	(0.0203)	(0.0095)	(0.5780)
Financial controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Governance controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macroeconomic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.503	0.479	0.293	0.360	0.617	0.559	0.227	0.135
Obs.	1122	886	1125	892	1123	886	927	936

Matched samples. The dependent variables by column are indicated in the table header; their definitions are presented in Section 3.2. and Table 1. Crisis is a dummy that takes the value of 1 for years 2008-2010, and zero for 2005-2007. High CSR is a dummy variable equal to one if the firms CSR level is above the median-year CSR, and zero if the firm's CSR score is below the median-year value. The controls are: technical efficiency, ln(Total assets), cash to sales (except in column 8), leverage, strategic holdings, CEO duality, women on board, board size, ln(Intangibles), ln(R&D), ln(Mkt. cap./GDP) and GDP growth and ln(GDP per capita); complete definitions are provided in Section 3.2 and Table 1. Firm-clustered standard errors are presented in parenthesis. * $p<0.10$, ** $p<0.05$, *** $p<0.01$

Appendix Table A1. Explanatory factors of technical efficiency: Full Sample

y: TE_{t+1}	(1)	(2)	(3)	(4)	(5)
Ln(Total assets)$_{it}$	-0.0028*	-0.0039*	-0.0058**	-0.0121***	-0.0890***
	(0.0017)	(0.0020)	(0.0028)	(0.0041)	(0.0118)
Cash to sales$_{it}$	-0.0085***	-0.0101***	-0.0096***	-0.0091***	0.0006
	(0.0008)	(0.0007)	(0.0007)	(0.0010)	(0.0007)
Leverage$_{it}$	-0.0791**	-0.0688**	-0.0799**	-0.0634*	-0.0276
	(0.0306)	(0.0290)	(0.0317)	(0.0351)	(0.0280)
Strategic holdings$_{it}$			-0.0012***	-0.0004	-0.0003***
			(0.0003)	(0.0002)	(0.0001)
Board independence$_{it}$			-0.0001		
			(0.0002)		
CEO duality$_{it}$			0.0152*	0.0100	0.0039
			(0.0083)	(0.0079)	(0.0041)
Women on board$_{it}$			0.0019***	0.0010*	-0.0008***
			(0.0004)	(0.0005)	(0.0003)
Board size$_{it}$			-0.0026**	-0.0014	-0.0002
			(0.0013)	(0.0011)	(0.0004)
ln(Intangibles)$_{it}$				0.0098***	0.0120***
				(0.0028)	(0.0028)
ln(R&D)$_{it}$				0.0025	0.0090***
				(0.0024)	(0.0029)
ln(Mkt. cap./GDP)$_{it}$				0.0221	0.0203**
				(0.0153)	(0.0088)
GDP growth$_{it}$				-0.0074**	-0.0018
				(0.0032)	(0.0014)
ln(GDP per capita)$_{it}$				0.0165	0.0194
				(0.0387)	(0.0183)
Constant	0.8877***	0.8952***	0.9648***	0.5348	1.6587***
	(0.0390)	(0.0421)	(0.0592)	(0.4221)	(0.2930)
Industry FE	No	Yes	Yes	Yes	No
Year FE	No	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	Yes
R-squared	0.202	0.255	0.303	0.282	0.193
Obs.	3481	3481	1702	2651	2651

The dependent variable is technical efficiency (TE) in period t+1, obtained from the estimations in columns (9) and (10) in Table 2. Complete definitions of all variables are provided in Section 3.2 and Table 1. Firm-clustered standard errors are presented in parenthesis. * p<0.10, ** p<0.05, *** p<0.01

Appendix Table A2. Matched sample pre-crisis: *t*-tests of balanced covariates

	Low CSR		High CSR		t-test
	Mean	Std. Err.	Mean	Std. Err.	p-value
Matching covariates					
ln(Total Assets)	16.4403	0.1064	16.4695	0.1103	0.8489
Cash to sales	10.1382	0.2408	10.1691	0.2417	0.9280
Leverage	0.5858	0.0065	0.5904	0.0064	0.6136
Additional variables					
Strategic holdings	27.7314	1.0842	25.6500	1.0475	0.1678
Women on board	6.2044	0.4356	6.1820	0.4478	0.9714
ln(Intangibles)	13.5206	0.1159	13.6745	0.1249	0.3668
ROA	0.0925	0.0024	0.0907	0.0025	0.5871

Complete definitions of all variables are provided in Section 3.2 and Table 1.